New Jersey Department of Environmental Protection
Division of Science and Research
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Water Monitoring Project
Water Monitoring Management

James E. Mumman, Administrator

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REAPPRAISAL

SHELLFISH GROWING AREA SE-1

ABSECON BAY, REEDS BAY AND BEACH THOROFARE

1994 - 1997

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SHELLFISH GROWING AREA SE-1

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New Jersey Department of Environmental Protection
ROBERT C. SHINN, Jr.
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EXECUTIVE SUMMARY

The water quality data presented in this Reappraisal Report was collected between January 1994, and December 1997. The water quality information was consistent with the existing shellfish growing water classification for SE-1. The main impact to the waters in this area are from non-point sources and storm water runoff. There are many marinas throughout this area as well as increased boating activities.

INTRODUCTION

PURPOSE

This report is part of a series of studies having a dual purpose. The first and primary purpose is to comply with the guidelines of the National Shellfish Sanitation Program (NSSP) that are established by the Interstate Shellfish Sanitation Conference (ISSC). Reports generated under this program form the basis for classifying shellfish waters for the purpose of harvesting shellfish for human consumption. As such, they provide a critical link in protecting human health.

The second purpose is to provide input to the State Water Quality Inventory Report, which is prepared pursuant to Section 305(b) of the Federal Clean Water Act (P.L. 95-217). The information contained in the growing area reports is used for the New Jersey State Water Quality Inventory Report (305b) which provides an assessment to Congress every two years of current water quality conditions in the State's major rivers, lakes, estuaries, and ocean waters. The reports provide valuable information for the 305(b) report, which describes the waters that are attaining state designated water uses and national clean water goals; the pollution problems identified in surface waters; and the actual or potential sources of pollution. Similarly, the reports utilize relevant information contained in the 305(b) report, since the latter assessments are based on instream monitoring data (temperature, oxygen, pH, total and fecal coliform bacteria, nutrients, solids, ammonia and metals), land-use profiles, drainage basin characteristics and other pollution source information.

From the perspective of the Shellfish Classification Program, the reciprocal use of water quality information from reports represent two sides of the same coin: the growing area report focuses on the estuary itself, while the 305(b) report describes the watershed that drains to that estuary.

The Department participates in a cooperative National Environmental Performance Partnership System (NEPPS) with the USEPA which emphasizes ongoing evaluation of issues associated with environmental regulation, including assessing impacts on waterbodies and measuring improvements in various indicators of environmental health. The shellfish growing area reports are intended to provide a brief assessment of the growing area, with particular emphasis on those factors that affect the quantity and quality of the shellfish resource. As the Department implements a comprehensive

watershed management program in conjunction with the NEPPS initiative, the shellfish growing area reports provide valuable information on the overall quality of the saline waters in the most downstream sections of each major watershed. In addition, the reports assess the quality of the biological resource and provide a reliable indicator of potential areas of concern and/or areas where additional information is needed to accurately assess watershed dynamics.

HISTORY

As a brief history, the NSSP developed from public health principles and program controls formulated at the original conference on shellfish sanitation called by the Surgeon General of the United States Public Health Service in 1925. This conference was called after oysters were implicated in causing over 1500 cases of typhoid fever and 150 deaths in 1924. The tripartite cooperative program (federal, state and shellfish industry) has updated the program procedures and guidelines through workshops held periodically until 1977. Because of concern by many states that the NSSP guidelines were not being enforced uniformly, a delegation of state shellfish officials from 22 states met in 1982 in Annapolis, Maryland, and formed the ISSC. The first annual meeting was held in 1983 and continues to meet annually at various locations throughout the United States.

Parts I and II of the NSSP Manual set forth the principles and requirements for the sanitary control of shellfish produced and shipped in interstate commerce in the United States. They provide basis used by the Federal Food and Drug Administration (FDA) in evaluating state shellfish sanitation programs. There are five major points on which the state is evaluated by the FDA include:

1. The classification of all actual and potential shellfish growing areas as to their suitability for shellfish harvesting.
2. The control of the harvesting of shellfish from areas that are classified as restricted, prohibited or otherwise closed.
3. The regulation and supervision of shellfish resource recovery programs.
4. The ability to restrict the harvest of shellfish from areas in a public health emergency, and
5. Prevent the sale, shipment or possession of shellfish that cannot be identified as being produced in accordance with the NSSP and have the ability to condemn, seize or embargo such shellfish.

FUNCTIONAL AUTHORITY

The authority to carry out these functions is divided between the Department of Environmental Protection (DEP), the Department of Health and Senior Services and the Department of Law and Public Safety. The Bureau of Marine Water Monitoring (BMWM) under the authority of N.J.S.A. 58:24 classifies the shellfish growing waters and administers the special resource recovery programs. Regulations delineating the

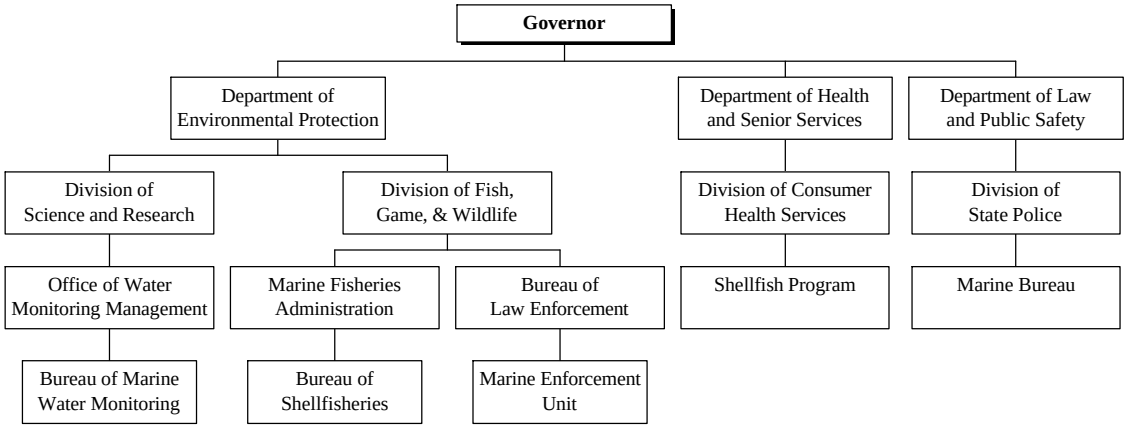
growing areas are promulgated at N.J.A.C. 7:12 and are revised annually. Special Permit rules are also found at N.J.A.C. 7:12 and are revised as necessary.

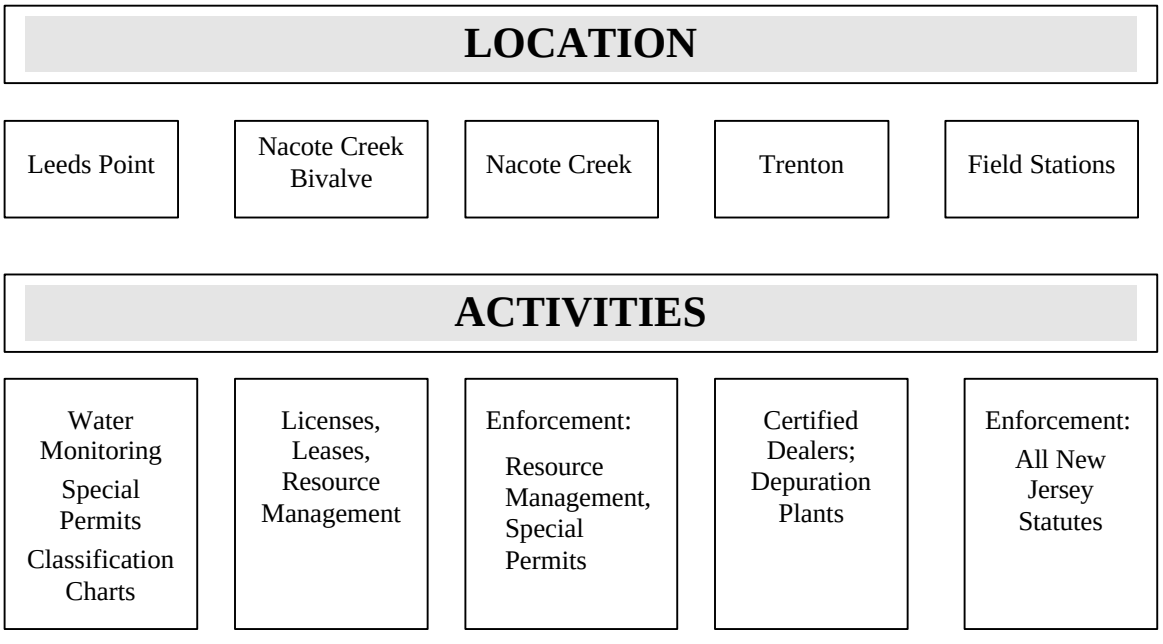
The Bureau of Shellfisheries in the Division of Fish, Game and Wildlife issues harvesting licenses and leases for shellfish grounds under the Authority of N.J.S.A. 50:2 and N.J.A.C. 7:25. This bureau in conjunction with the BMWM administers the Hard Clam Relay Program.

The Bureau of Law Enforcement in the DEP (Division of Fish, Game, and Wildlife) and the Division of State Police in the Department of Law and Public Safety enforce the provisions of the statutes and rules mentioned above.

The Department of Health is responsible for the certification of wholesale shellfish establishments and in conjunction with the BMWM, administers the depuration program.

Figure 1: STATE OF NEW JERSEY SHELLFISH AGENCIES





IMPORTANCE OF SANITARY CONTROL OF SHELLFISH

Emphasis is placed on the sanitary control of shellfish because of the direct relationship between pollution of shellfish growing areas and the transmission of diseases to humans. Shellfish borne infectious diseases are generally transmitted via a fecal-oral route. The pathway is complex and quite circuitous. The cycle usually begins with fecal contamination of the shellfish growing waters. Sources of such contamination are many and varied. Contamination reaches the waterways via runoff and direct discharges.

Clams, oysters and mussels pump large quantities of water through their bodies during the normal feeding process. During this process the shellfish also concentrate microorganisms, which may include pathogenic microbes, and toxic heavy metals/chemicals. It is imperative that a system is in place to reduce the human health risk of consuming shellfish from areas of contamination.

Accurate classifications of shellfish growing areas are completed through a comprehensive sanitary survey. The principal components of the sanitary survey report include:

1. An evaluation of all actual and potential sources of pollution,
2. An evaluation of the hydrography of the area and
3. An assessment of water quality. Complete intensive sanitary surveys are conducted every 12 years with interim narrative evaluations completed on a three year basis. If major changes to the shoreline or bacterial quality occur, then the intensive report is initiated prior to its l2 year schedule.

The following narrative constitutes this bureau's assessment of the above mentioned components and determines the current classification of the shellfish growing waters.

DESCRIPTION

DESCRIPTION

Area SE-1 is located in Atlantic County and includes waters from Great Bay down to but not including Lakes Bay. This area can be found on charts 6 and 7 of the “State of New Jersey-Shellfish Growing Water Classification Charts”. The principal water bodies in this area are Reeds Bay, Absecon Bay and Little Bay. There are also several thorofares and channels throughout area SE-1 such as Absecon Channel, Beach Thorofare and the Bonita Tideway. It is bordered by four municipalities, the statistics for which are shown below in Table I.

LOCATION

Figure 2: Location of Shellfish Growing Area SE-1

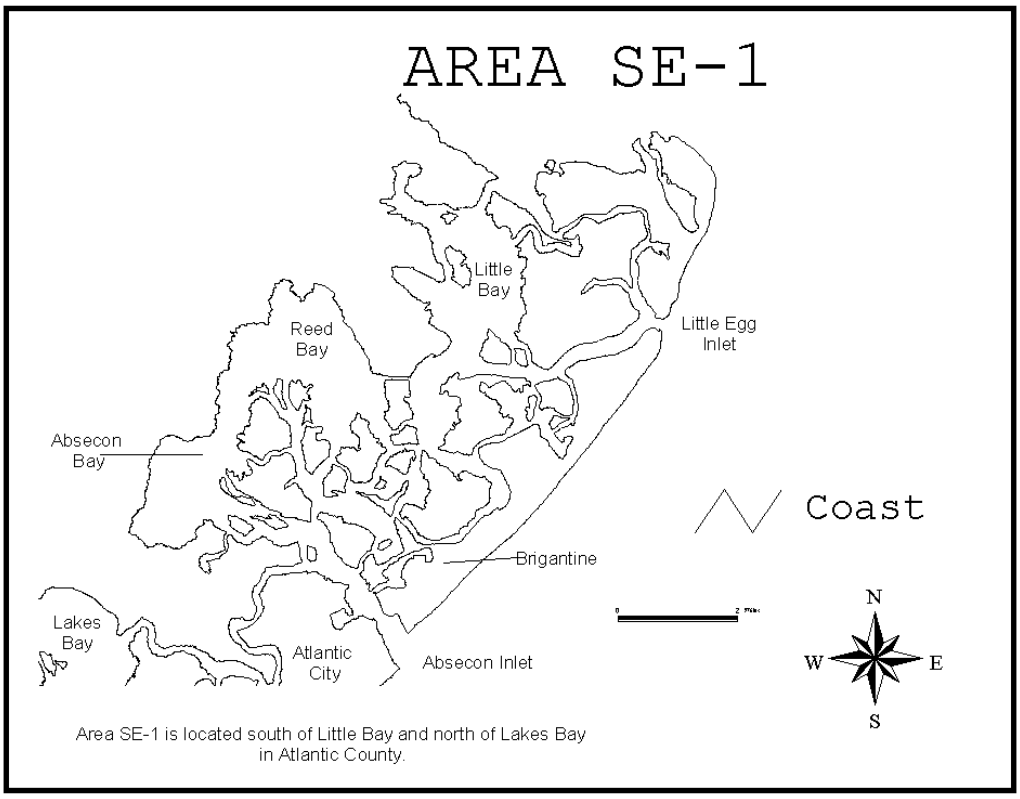
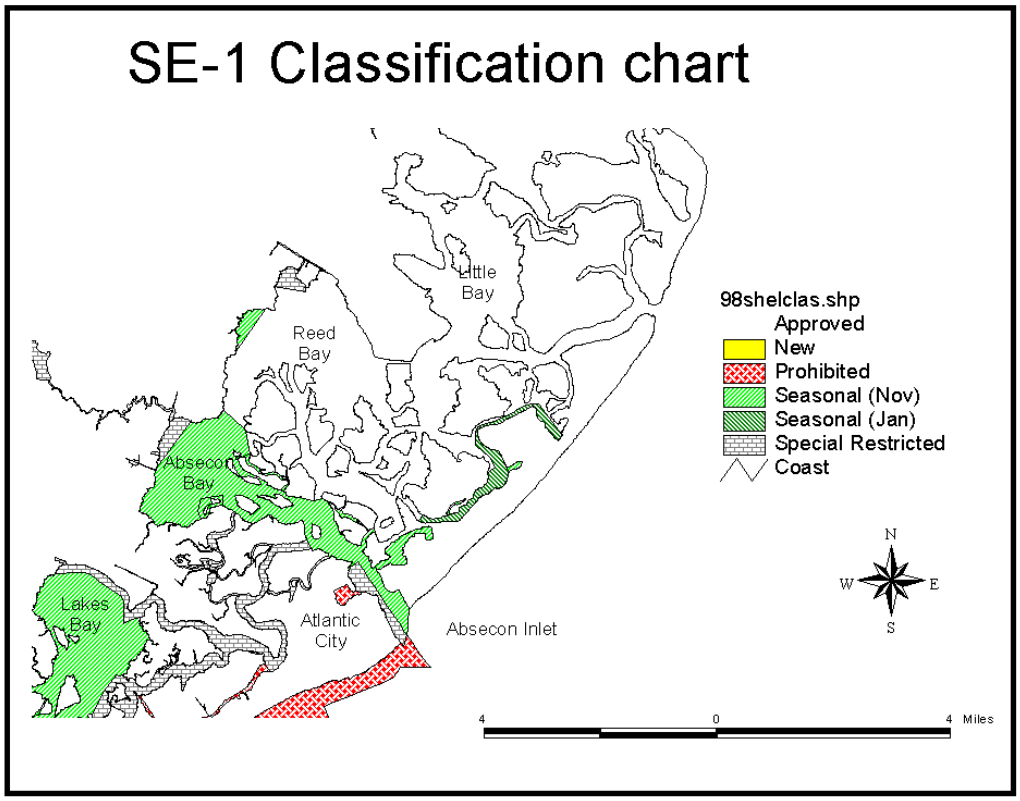


Table 1 : Summary of Population Statistics

Municipality	**Population**	**Population Density (persons/sq mi)**
Galloway Township	23330	258
Absecon	7298	1276
Atlantic City	37986	3348
Pleasantville	16027	2761

Figure 3 : Area SE-1 classification



HISTORY

The majority of area SE-1 is classified as Approved or Seasonally Approved. This was largely based on the elimination of wastewater discharges to the back bay area in the early 1980's. Prior to this time approximately half of area SE-1 was classified as Prohibited for shellfish harvesting. The last major change in classification of these waters occurred in 1987, when most of the Condemned waters were upgraded to Special Restricted. This change was not due to a change in water quality, but the result of an administrative change. The waters had previously been classified as condemned because they were not sampled. Once they were scheduled for sampling they were classified as Special Restricted, which actually coincided with the quality of the waters. There have been no major changes in the classification of the waters in area SE-1 since then.

The main resource in this area is hard clams (*Mercenaria mercenaria*). The higher densities of hard clams can be found in St. Georges Thorofare.

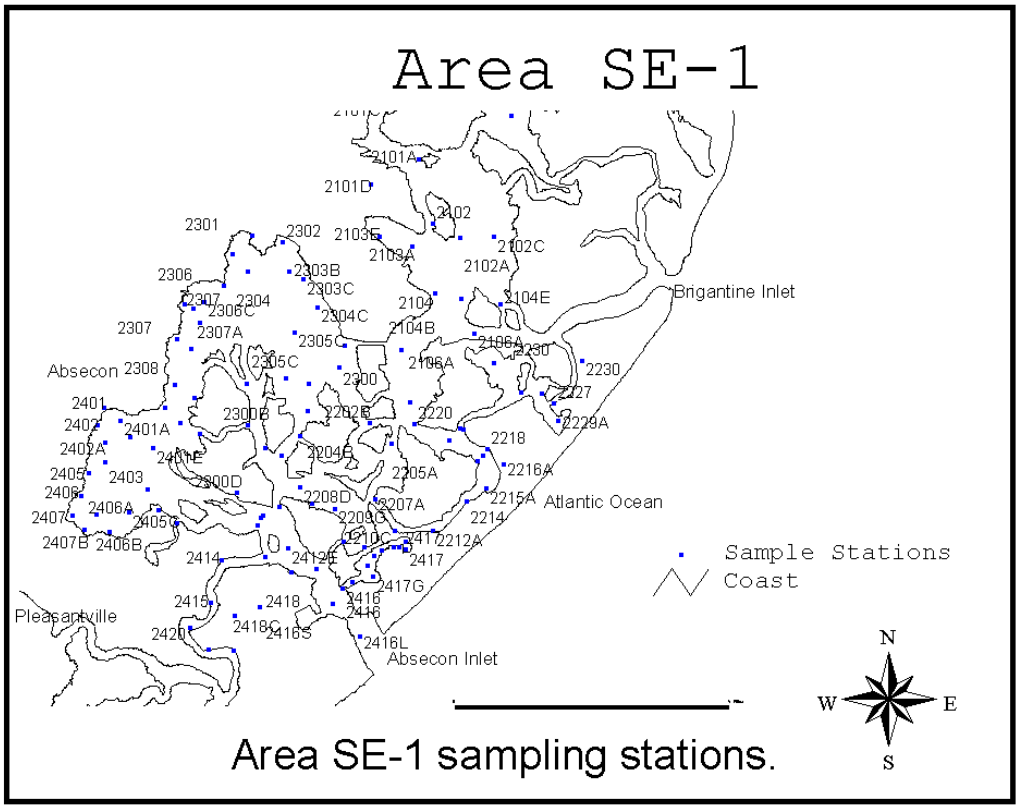
The last Sanitary Survey for area SE-1 was dated October 1995, and covered data from January 1988 through December 1994.

METHODS

Water sampling was performed in accordance with the Field Procedures Manual (NJDEP, 1992).

Approximately 2680 water samples were collected for total and fecal coliform bacteria between 1995 and 1997 and analyzed by the three tube MPN method according to APHA (1970). Figure 4 shows the Shellfish Growing Water Quality monitoring stations in area SE-1. Approximately 116 stations are monitored during each year.

Figure 4: Area SE-1 sampling stations



Water quality sampling, shoreline and watershed surveys were conducted in accordance with the NSSP Manual of Operations, Part I, Appendix B (USPHS, 1995).

Data management and analysis was accomplished using database applications developed for the Bureau. Mapping of pollution data was performed with the Geographic Information System (GIS:ARCVIEW).

BACTERIOLOGICAL INVESTIGATION AND DATA ANALYSIS

The water quality of each growing area must be evaluated before an area can be classified as *Approved, Seasonally Approved, Special Restricted,* or *Seasonal Special Restricted.*

Criteria for bacterial acceptability of shellfish growing waters are provided in Part I of National Shellfish Sanitation Program Manual of Operations - 1995 Revision. Each shellfish producing state is directed to adopt either the total coliform criterion, or the fecal coliform criterion. While New Jersey bases its growing water classifications on the total coliform criterion, it does make corresponding fecal coliform determinations for each sampling station, these data are viewed as adjunct information and are not directly used for classification. The State Shellfish Control Authority also has the option of choosing one of the two water monitoring sampling strategies for each growing area.

The Adverse Pollution Condition Strategy requires that a minimum of five samples be collected each year under conditions that have historically resulted in elevated coliforms in the particular growing area. The results must be evaluated by adding the individual station sample results to the preexisting bacteriological sampling results to constitute a data set of at least 15 samples for each station. The adverse pollution conditions usually are related to tide, and rainfall, but could be from a point source of pollution or variation could occur during a specific time of the year. Under this strategy, for *Approved* waters, the total coliform median or geometric mean MPN of the water shall not exceed 70 per 100 mL and not more than 10 percent of the samples exceed an MPN of 330 per 100 mL for the 3-tube decimal dilution test. For *Special Restricted* waters, the total coliform median or geometric mean MPN of the water shall not exceed 700 per 100 mL and not more than 10 percent of the samples exceed an MPN of 3300 per 100 mL for the 3-tube decimal dilution test. Areas to be Approved under the Seasonal classification must be sampled and meet the criterion during the time of the year that it is approved for the harvest of shellfish.

The Systematic Random Sampling strategy requires that a random sampling plan be in place before field sampling begins and can only be used in areas that are not affected by point sources of contamination. A minimum of six samples per station are to be collected each year and added to database to obtain a sample size of 30 for statistical analysis. The bacteriological quality of every sampling station in *Approved* areas shall have a total coliform median or geometric mean MPN not exceeding 70 per 100 mL and the estimated 90th percentile shall not exceed an MPN of 330 per 100 mL. For *Special Restricted* areas, the bacteriological quality shall not exceed a total coliform median or geometric mean MPN of 700 per 100 mL and the estimated 90th percentile shall not exceed an MPN of 3,300 per 100 mL.

Area SE-1 was sampled using the Adverse Pollution Condition strategy with an ebb tide preference for the time period referenced in this report.

MARINE BIOTOXINS

The Department collects samples at regular intervals throughout the summer to determine the occurrence of marine biotoxins. This data is evaluated weekly by the Bureau of Marine Water Monitoring in accordance with the NSSP requirements. An annual report is compiled by the Bureau of Freshwater and Biological Monitoring.

SHORELINE SURVEY

EVALUATION OF BIOLOGICAL RESOURCES

An in-depth shoreline investigation can be found in the Sanitary Survey dated October 1995. There have been no significant changes since that survey.

LAND USE

The Forsythe National Wildlife Refuge has a definite non-point source impact on area SE-1. There is a significant wildlife population that is in and around this refuge. The refuge is located off Doughty Creek which enters into Somers Cove, located on the north western corner of Reed Bay. The Somers Cove area is classified Special Restricted.

CHANGES SINCE LAST SURVEY

All of Atlantic City is sewered. In the previous Sanitary Survey it was noted that there was developed land east of Albany Ave on Great Island that was not sewered. However, with the building of the new Atlantic City High School on Great Island, the developed land previously referred to has been connected to the collection system.

IDENTIFICATION AND EVALUATION OF SOURCES

Marinas

Marina facilities have the potential to affect the suitability of shellfish growing areas for the harvest of shellfish. The biological and chemical contamination associated with marina facilities may be of public health significance. New Jersey defines a marina as "any structure (docks, piers, bulkheads, floating docks, etc.) that supports five or more boats, built on or near the water, which is utilized for docking, storing, or otherwise mooring vessels and usually but not necessarily provides services to vessels such as repairing, fueling, security or other related activities" and designates the confines of the marina as *Prohibited* for the harvest of shellfish. Adjacent waters are classified using a dilution analysis formula.

It is recognized by the National Shellfish Sanitation Program, Manual of Operations, Part1, Section C-9, that there are significant regional differences in all factors that affect marina pollutant loading. The manual therefore allows each state latitude in applying specified occupancy and discharge rates. The NSSP guidelines assume the worst case scenario for each factor.

There are 20 marinas in area SE-1, as shown in Table 2 and Figure 5. The marinas are located along the inland coast of Atlantic City and Brigantine. There are also a few located on the coast of Absecon Bay. The waters enclosed by the marina are classified as *Prohibited*; depending on the size of the marina and the water quality, water immediately adjacent to each marina may be classified as *Prohibited*, *Special Restricted*, or *Seasonally*

Approved (no harvest during summer months when the marina is active). Marina buffer zones were calculated using the formula below. The size of each buffer zone is shown in Table 2.

Table 2 : Marinas in Area SE-1.

Marina Name		Wet slips	Location	Buffer Radius(ft)	Depth (ft)
1	Waynes World Bait & Tackle	21	Absecon	649	4
2	Up the Creek Marina	35	Absecon	838	4
3	Absecon Bay & Sportsman Center	20	Absecon	634	4
4	Jersey State Marina	38	Brigantine	451	15
5	Condominium Marina	38	Brigantine	451	15
6	Elks Lodge Marina	50	Brigantine	517	15
7	Deebold Boat Yard	21	Brigantine	335	15
8	Bobs Outboard	24	Brigantine	358	15
9	Donalds Marina	24	Brigantine	347	16
10	Jolly Roger Marina	18	Brigantine	292	17
11	Fish & Fun Marina	22	Brigantine	313	18
12	Conway Marina	25	Brigantine	317	20
13	Bayside Marina	50	Brigantine	634	10
14	AC Fishing Center	12	Atlantic City	283	12
15	M & W Boat Works	11	Atlantic City	271	12
16	Snug Harbor Marina	7	Atlantic City	216	12
17	Kammerman's Marina	8	Atlantic City	231	12
18	A.C. Wescoat Co.	0	Atlantic City	0	12
19	Farley State Marina	640	Atlantic City	2926	6
20	Harrah's Marina	107	Atlantic City	846	12

Marina Buffer Equation. (adapted from FDA. 1989):

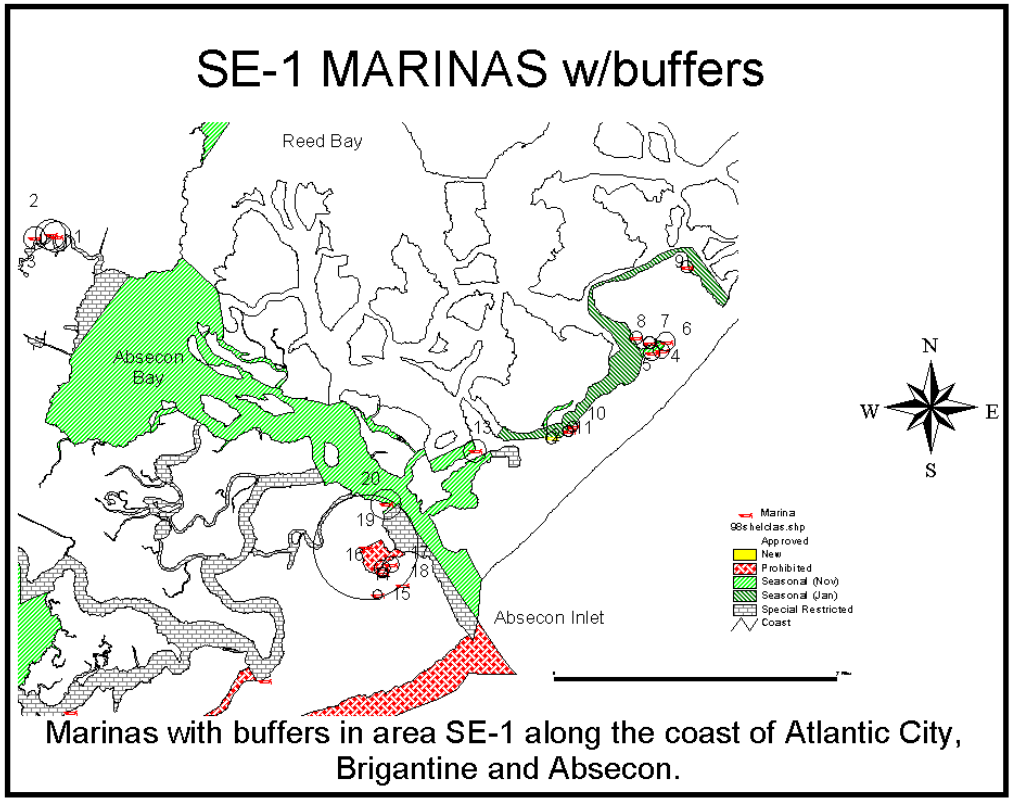
$$BufferRadius(ft) = \sqrt{\frac{2x10^{9}(FC/person/day)x2(person/boat)x(.25slips)x2}{140000(FC/M^{3})xdepth(ft)x0.3048(M/ft)xpx2(tides/day)}}x3.28(ft/M)$$

Explanation of terms in equation:

Fecal coliform per person per day:	2 x 10^{9}
Number of people per boat:	2
Number of slips occupied:	50% (only those able to accommodate a boat > 24 feet in length)
Number of boats occupied:	50%
Angle of shoreline:	180^{o}, which results in factor of 2
Number of tides per day:	2
Depth in meters:	depth in feet x conversion factor
Water quality to be achieved:	140000 FC/$meter^{3}$
Buffer in feet:	convert meters to feet using conversion factor

Marina buffer zones may be calculated using the formula above, or may be determined using a dilution analysis computer program developed by the State of Virginia and the USFDA. The computer program is used for complex configurations where the formula is unlikely to provide the needed accuracy.

Figure 5: Marinas showing buffer zones surrounding marina



Marinas with buffers in area SE-1 along the coast of Atlantic City, Brigantine and Absecon.

HYDROGRAPHY AND METEOROLOGY

A detailed hydrography report was completed for area SE-1 in the Sanitary Survey dated October 1995. There has been no significant change in hydrography since the last report.

Precipitation inputs to the area for the period 1995 through 1997 are shown in the Climatological Data table. The primary weather station for this area is Pomona. The secondary weather station for this area is Atlantic City. The secondary station data is used when data from the primary station is incomplete.

Table 3 : Climatological Data

Rainfall Recorded at NOAA's Pomona Station at 1200 hrs; Wind and Temperature aboard sampling vessel at time of sample collection

Sampling Date	Precipitation in Inches			
	Sampling day	1 day prior	2 days prior	3 days prior
01/13/95	0.000	0.000	0.000	0.000
01/19/95	0.000	0.000	0.000	0.280
02/17/95	0.000	0.110	0.510	0.510
03/02/95	0.000	0.000	0.340	0.350
03/07/95	0.000	0.000	0.000	0.000
03/17/95	0.000	0.000	0.000	0.000
03/27/95	0.000	0.000	0.000	0.000
03/30/95	0.010	0.010	0.010	0.010
04/03/95	0.000	0.030	0.030	0.030
04/12/95	0.470	0.470	0.500	0.590
04/17/95	0.000	0.000	0.000	0.000
04/20/95	0.000	0.000	0.000	0.000
04/24/95	0.310	0.310	0.390	0.410
05/12/95	0.000	0.000	1.440	1.460
06/20/95	0.000	0.000	0.000	0.000
06/30/95	0.000	0.000	0.000	0.000
08/09/95	0.000	0.000	0.030	2.980
08/11/95	0.000	0.000	0.000	0.000
09/25/95	0.000	0.000	1.170	1.190
10/27/95	0.000	0.000	0.000	0.000
10/30/95	0.000	0.160	0.420	0.420
06/04/96	0.690	-1.000	-1.000	-1.000
08/20/96	0.000	0.000	0.490	0.490
09/04/96	0.000	0.000	0.000	0.010
09/06/96	0.000	0.000	0.000	0.000
09/11/96	0.040	0.040	0.050	0.050
10/02/96	0.000	0.010	0.090	0.600
10/15/96	0.000	0.000	0.000	0.000
10/17/96	0.000	0.000	0.000	0.000
10/28/96	0.160	0.160	0.160	0.160
11/07/96	0.020	0.020	0.020	0.020
11/18/96	0.000	0.000	0.000	0.000
12/17/96	0.200	0.200	0.440	1.740

Sampling Date	Precipitation in Inches			
	Sampling day	1 day prior	2 days prior	3 days prior
02/25/97	0.000	0.000	0.040	0.050
03/25/97	0.000	0.000	0.000	0.000
04/08/97	0.000	0.240	0.280	0.280
04/11/97	0.000	0.000	0.000	0.000
04/28/97	1.650	1.650	1.650	1.770
05/06/97	0.020	0.020	0.060	0.180
05/08/97	0.000	0.200	0.220	0.220
05/23/97	0.000	0.000	0.000	0.120
07/07/97	0.000	0.000	0.000	0.000
08/04/97	0.000	0.000	0.000	0.000
10/06/97	0.000	0.000	0.000	0.000
10/27/97	0.790	0.800	1.710	1.710
10/28/97	0.010	0.800	0.810	1.720
11/03/97	0.080	0.830	0.850	0.850

WATER QUALITY STUDIES

BACTERIOLOGICAL QUALITY

The raw data listings and statistical summaries according to National Shellfish Sanitation Program (NSSP) criteria are given in the appendix. There were no stations that exceeded the NSSP criteria.

INTERPETATION AND DISCUSSION OF DATA

BACTERIOLOGICAL

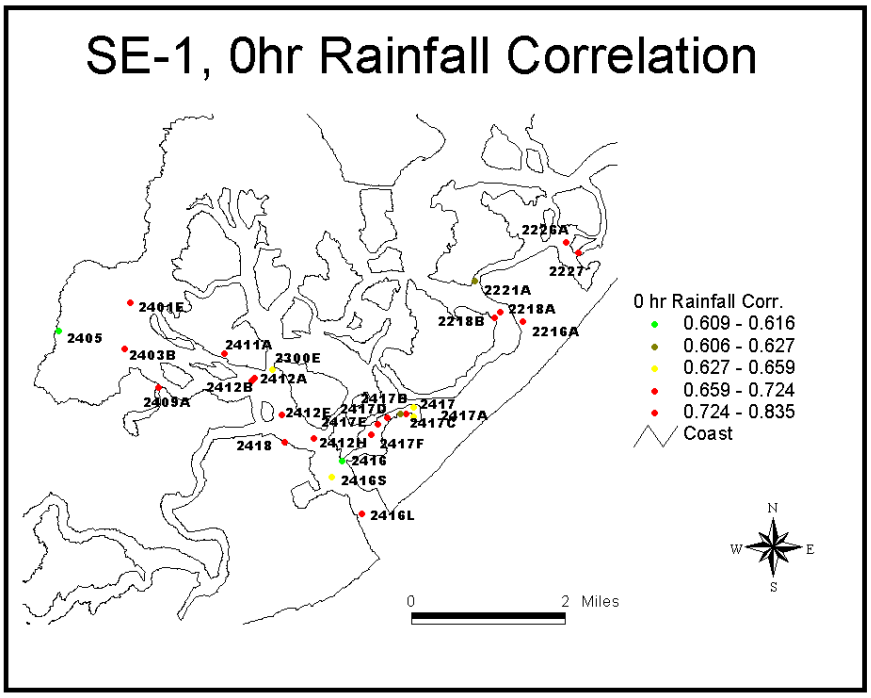
Criteria for bacterial acceptability of shellfish growing waters are provided in Part I of the National Shellfish Sanitation Program's Manual of Operations, 1995 Revisions. Each shellfish producing state is directed to adopt either the total coliform or the fecal coliform criteria for growing water classifications. Historically, New Jersey based growing water classifications on the total coliform criteria and is using these criteria currently.

The total coliform median or geometric mean MPN (most probable number) does not exceed 70 per 100 mL and not more than 10% of the samples exceed an MPN of 330 per 100mL where the three tube decimal dilution test. The total coliform standard need not be applied if it can be shown by detailed study verified by laboratory findings that the coliforms are not of direct fecal origin and do not indicate a public health hazard.

While New Jersey does make corresponding fecal coliform determinations for each total coliform determination, this data is viewed as adjunct information and is not directly used for classification.

Based on the water quality data collected only one station showed a significant tidal component. However, out of the 18 samples taken only three of the samples were taken on a flood tide. It had previously been determined that the adverse condition for area SE-1 was during the Ebb tide. Therefore, this area was monitored under an Ebb tide preference for this time period. Although the water quality data collected showed that area SE-1 was still in compliance with the existing classification, we were unable to evaluate the ebb vs flood tide data. This was due to the lack of data collected during flood tide conditions. With the increase in staff, we will be able to collect additional runs, (during flood tide conditions), which will allow the evaluation of ebb and flood tide conditions.

Figure 6 : Rainfall Correlation (Day of Sampling)



A significant correlation to rainfall was found to occur at 42 out of 118 of the stations sampled in area SE-1, (36%of stations sampled). There were 27 stations that showed a correlation on the day of sampling, (see Figure 6). The stations with the highest correlation on the day of sampling were located throughout Absecon Inlet, Absecon Channel into the Absecon Bay.

There were also several stations with a high correlation along Peter Beach and Brigantine Boulevard as well as in the Bonita Tideway. Nineteen stations showed a correlation at one day prior to sampling,(see Figure 7). At this time the rainfall correlation was in the Absecon Inlet, Absecon Channel and Absecon Bay, however the actual correlation values were less. There was also little to no correlation along the Brigantine Boulevard.

Figure 7: Rainfall Correlation (One day prior to sampling)

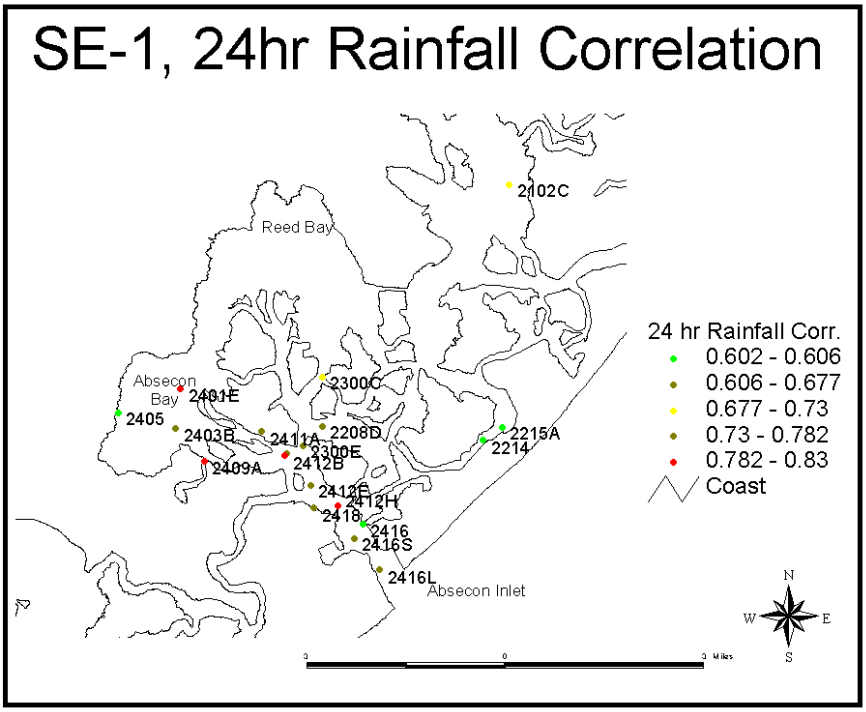
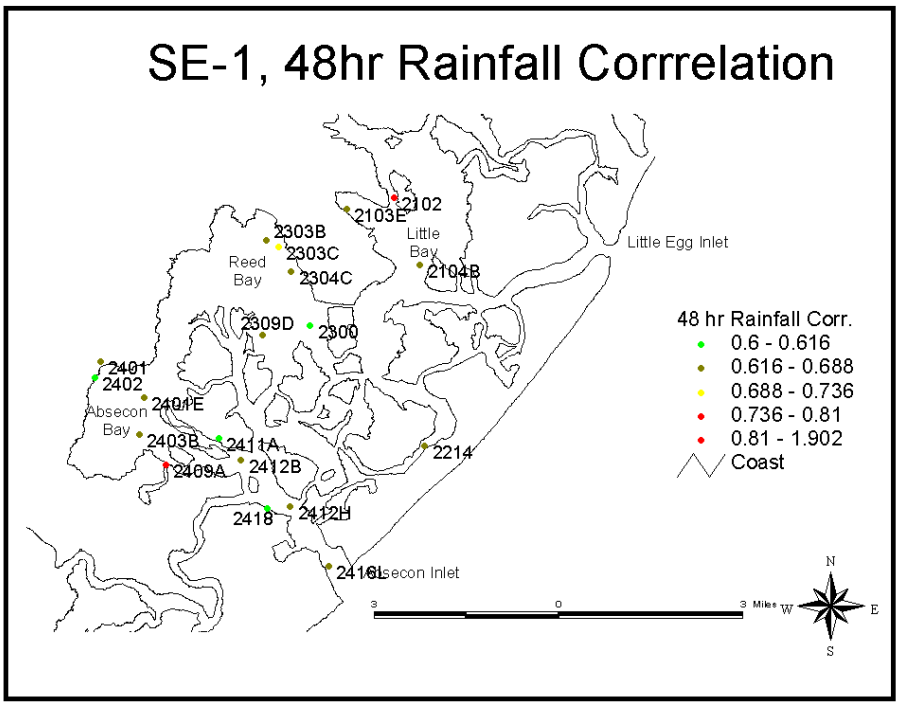


Figure 8: Rainfall Correlation (Two days prior to sampling)



Nineteen stations showed a correlation at two days prior, (see Figure 8). By this time the actual correlation values had decreased considerably. Additionally, the location of the stations had shifted. Now the stations were located in Little Bay, Reed Bay and Absecon Bay. There were still stations located in the Absecon Inlet and Channel that showed a correlation. Eight stations showed a correlation all three days. Six stations showed a correlation on the day of sampling and one day prior, while only one station showed a correlation for the two days prior to day of sampling. The stations were located throughout area SE-1. For these reasons area SE-1 should be considered a rainfall impacted area. There were nine sampling days that within the sampling time period for this report that did not have rainfall data recorded at the Pomona or the Atlantic City stations. The missing data effected the time period between December 1995 through June 1996. However, it was determined that the rainfall data available from January 1995, through November 1997 was enough to give an accurate representation of the effect of rainfall in area SE-1.

There was a very slight seasonality to water quality found in Area SE-1. Only 2% of the stations sampled showed a slightly higher total coliform geometric mean during the summer than during the winter, (see table below).

Table 4 : Summer versus winter conditions.

T-test comparing total coliform MPN values under summer versus winter conditions.

Station[1]	Geometric Mean Total Coliform MPN		Prob>[T][2]
	Summer	Winter	
2220	4.5	3.0	0.03677
2221	6.3	3.5	0.03499
2308C	7.6	3.1	0.02121

CONCLUSIONS

BACTERIOLOGICAL EVALUATION

Water quality in Area SE-1 is generally good with all of the stations meeting the NSSP total coliform criteria for the applicable classification. The area has the potential for improvement with the sewering of the area near the Atlantic City High School.

[1] Only stations showing significant differences are listed.
[2] T-test significance level (probability of a greater T statistic with equal means).

RECOMMENDATIONS

BACTERIOLOGICAL EVALUATION

No change in water classification is recommended at this time for area SE-1. Although the water quality is very good in this area there is still a large potential for degradation of the waters based in part on the large amount of boating activities. It is recommended, however, that additional runs be collected whenever possible, on the flood tide. This would allow for a better evaluation of tidal conditions. Additionally, with the correlation to rainfall that was shown in this area it is recommended that the sampling protocol should be changed from Adverse Pollution to Systematic Random Sampling.

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APPENDICES

Appendices noted in this report are not available for download.